ARTICLE V.

Observations to determine the Magnetic Intensity at several Places in the United States, with some additional Observations of the Magnetic Dip. By Elias Loomis, Professor of Mathematics and Natural Philosophy in Western Reserve College. Read Nov. 6, 1840.

Magnetic Intensity.

In the autumn of 1839, while engaged upon a series of observations for the magnetic dip, the results of which are given in the Society's Transactions, Vol. VII, pp. 101—111, Professor Renwick of New York kindly offered me the use of his apparatus for magnetic intensity. The offer was gladly accepted, and observations made with the needles whenever circumstances would permit. As I had not yet learned to observe alone, and it was seldom I could find a suitable assistant, the observations were few in number; and I should not think them worthy the attention of the Society, were it not that they furnish an approximate value of the magnetic intensity at one station somewhat remote from the Atlantic coast, and in a region where such observations have been seldom attempted.

The apparatus employed in these observations was constructed after the model of that of Professor Hansteen. Three needles were used. The first, made under the direction of Professor Hansteen himself, is 2.35 inches in length, and .16 inch in diameter, mounted in a stirrup of parchment. The second, which was furnished by Major Sabine, is 2.34 inches long, and .14 inch in diameter, mounted in a brass stirrup. The third, by Professor Henry, is 2.40 inches long, .15 inch in diameter, mounted in a silk stirrup. The needles are accor-

dingly distinguished by the names of Hansteen, Sabine, and Henry. They were enclosed in a small cylindrical box of wood, supported by levelling screws, and having a glass tube fitted to the top, from which the needles were suspended by a few filaments of the silkworm's thread. At the bottom of the box was a divided circle for the purpose of noting the arc of vibration, and the temperature was shown by an enclosed thermometer. The bottom of the box being rendered horizontal, and the needle properly placed in the stirrup, it was drawn aside from the magnetic meridian by bringing near it another needle. The registry of the oscillations was commenced when the half arc of vibration was reduced to 30°, and continued to 320 oscillations, the instant of the completion of every tenth vibration being noted. The amplitude of the final arc was generally recorded, being about five degrees. Five intervals of time were thus obtained, each corresponding to 280 vibrations, namely, the interval between the 0th, and 280th vibration, between the 10th, and 190th, etc., and between the 40th and 320th; and the mean of these is taken as the result.

At Dorchester, Princeton, and Philadelphia, the times were noted by a chronometer. At the other stations, a lever watch was used. At Hudson, the watch was compared with the Observatory clock, immediately before and after the observations. At the remaining stations there is a little uncertainty with regard to the time, yet, it is thought, its influence upon the results will not be great.

No correction has been applied for the arc of vibration. In order to determine the correction for temperature, the apparatus was placed upon a large earthen plate, covered by a bell glass, alternately heated from below by a lamp, and surrounded by a freezing mixture. The usual mode of observation was employed, and the results are shown in the following table, the first column of which indicates the time of commencement of each series of observations.

Date.	Needle.	Time of 280 Vibrations.	Temp.	Date.	Needle.	Time of 280 Vibrations.	Temp.
1839, Dec. 11, 1^h 32^m P. M.	Sabine	$732^s.56$	30°.8	1840, Jan. 4, 1^h 28^m M. P.	Sabine	$732^s.06$	17°.9
" " 1 51 "	"	732 .10	28 .1	" " 1 45 "	"	731 .79	17 .1
" " 2 41 "	Hansteen	859 .36	29 .6	" " 2 32 "	Hansteen	858 .47	19 .9
" " 2 59 "	"	858 .42	26 .5	" " 2 53 "	"	859 .14	15 .7
" " 3 41 "	Henry	592 .36	34 .0	" " 3 47 "	Henry	591 .31	21 .7
" " 3 55 "	"	592 .20	30 .4	" " 4 3 "	"	593 .66	17 .9
" " 4 44 "	"	595 .18	89 .4	" " 4 45 "	"	597 .26	85 .0
" " 4 59 "	"	595 .64	90 .9	" " 5 1 "	"	598 .38	85 .0
" " 7 17 "	Hansteen	869 .93	91 .0	" " 7 0 "	Hansteen	870 .10	84 .3
" " 7 38 "	"	868 .29	91 .1	" " 7 20 "	"	870 .31	88 .8
" " 8 9 "	Sabine	745 .87	84 .2	" " 7 53 "	Sabine	748 .11	89 .4
" " 8 26 "	"	747 .31	85 .0	" " 8 11 "	"	746 .83	84 .0

The mean of the preceding observations furnish,

	Time of Vibration.	Temp.	Time of Vibration.	Temp.
Hansteen,	869s.64	88°.8	858s.85	22°.9
Sabine,	747 .03	85 .6	732 .13	23 .5
Henry,	596.61	87 .6	592 .38	26 .0

Then, by the usual formula $a = \frac{T - T'}{T(t - t')}$ we obtain:—

For Hansteen's needle, $a = \frac{10.79}{858.85 \times 65.9} = .000191.$

For Sabine's needle, $a = \frac{14.9}{732.13 \times 62.1} = .000328.$

For Henry's needle, $a = \frac{4.23}{592.38 \times 61.6} = .000116.$

The standard temperature, to which the following results are reduced, is 60° Fahrenheit. No correction is applied for the diurnal variation of intensity, but the hours of observation are always stated. To test the permanency of the magnetism of the needles, I have been furnished, by Prof. Renwick, with two series of observations, made at New York, besides those made in September, 1839. The results are as follows:

Needle.	Date.	Time of 280 Vibrations.	Temp.	Corrected Time.
Hansteen	1838, June 22, 0^h 6^m P. M.	873s.60	82°.0	869s.94
"	1839, Sept. 9, 11 13 A. M.	869 .40	86 .0	865 .09
"	1840, June 6, 0 4 P. M.	943 .60	80 .2	939 .97
Sabine	1838, June 21, 5 23 "	744 .35	77 .0	740 .21
"	1839, Sept. 9, 10 48 A. M.	744 .34	85 .2	738 .24
"	1840, June 6, 10 23 "	740 .00	78 .8	735 .44
Henry	1838, June 25, 10 21 "	590 .80	77 .0	589 .64
"	1839, Sept. 9, 11 38 "	596 .72	86 .2	594 .91
"	1840, June 6, 11 26 "	598 .20	79 .0	596 .88

In Sabine's needle, the time of vibration continually diminished, and in Henry's increased; indicating, in the former case, a slight increase of magnetic force, and in the latter a diminution. The inequality, however, does not much, if at all, exceed the irregular fluctuations of intensity which may be observed at a single station, within a moderate interval; and as the variation indicated in the two needles are opposite in kind, and will consequently, in part, balance each other in taking the mean, the magnetism of both is regarded as invariable. In Hansteen's needle there is a striking increase in the time of vibration

between 1839 and 1840. This is believed to be due to rust contracted in the interval. As, however, the rust was contracted after the subsequent observations, the magnetism of the needle throughout the series is regarded as invariable. The stations of observation were the same as for the dip formerly described, with the exception of that at Dorchester, which was near Mr. Bond's Observatory.

Place.	Date.	Needle.	Time of 280 Vibrations.	Temp.	Corrected Time.
New Haven, Conn.	1839, Sept. 11, 9^h 53^m A. M.	Sabine	$760^s.64$	81°.8	$755^s.21$
"	" " 10 24 "	"	763 .34	83 .0	757 .59
"	" " 10 55 "	Hansteen	887 .04	76 .4	884 .27
"	" " 11 24 "	Henry	609 .95	74 .8	608 .90
Dorchester, Ms.	" Sept. 18, 4 48 P. M.	Sabine	778 .24	78 .8	773 .45
"	" " 5 34 "	Hansteen	907 .06	75 .7	904 .35
"	" " 6 0 "	Henry	625 .08	72 .6	624 .17
Providence, R. I.	" Sept. 19, 4 59 "	Sabine	769 .32	70 .4	766 .70
"	" " 5 22 "	Hansteen	898 .92	68 .5	897 .46
Princeton, N. J.	" Sept. 21, 4 51 "	Sabine	739 .24	80 .7	734 .22
"	" " 5 40 "	Hansteen	865 .46	79 .2	862 .29
"	" " 6 3 "	Henry	595 .10	76 .9	593 .93
Philadelphia, Penn.	" Sept. 23, 4 46 "	Sabine	729 .26	70 .3	726 .80
"	" " 5 23 "	Hansteen	851 .68	67 .6	850 .45
"	" " 5 47 "	Henry	585 .28	65 .7	584 .89
Hudson, Ohio.	" Nov. 2, 1 23 "	Sabine	733 .85	58 .1	734 .31
"	" " 1 41 "	"	734 .75	55 .1	735 .93
"	" " 2 7 "	Hansteen	858 .13	54 .1	859 .09
"	" " 2 27 "	"	857 .66	51 .6	859 .03
"	" " 2 52 "	Henry	592 .61	52 .1	593 .15
"	" " 3 5 "	"	591 .41	53 .0	591 .89
"	" Nov. 30, 1 46 "	Sabine	732 .70	47 .6	735 .68
"	" " 2 3 "	"	732 .76	42 .6	736 .94
"	" " 2 24 "	Hansteen	858 .59	41 .0	861 .70
"	" " 2 45 "	"	858 .33	39 .8	861 .63
"	" " 3 10 "	Henry	591 .78	39 .1	593 .21
"	" " 3 23 "	"	591 .54	38 .2	593 .04
"	1840, Jan. 1, 1 40 "	Sabine	731 .48	23 .5	740 .23
"	" " 1 55 "	"	730 .36	21 .5	739 .57
"	" " 2 29 "	Hansteen	856 .63	25 .5	862 .26
"	" " 3 41 "	Henry	590 .75	27 .0	593 .01
"	" " 3 55 "	"	592 .47	16 .9	595 .44

The mean of the preceding observations furnish us with the following table, in which column third is computed from the formula $\frac{h}{h'} = \left(\frac{T'}{T}\right)^2$, and column sixth by multiplying the horizontal intensity by the secant of the dip. The last column represents the total intensity, that of New York being called 1.803, according to the determination of Major Sabine.

		Time.	Horizontal intensity.	Mean.	Dip.	Total inten-ity.	Total intensity.
New York,	Hansteen	$867^s.51$	.96105	.96707	72° 52'.2	1.00815	1.803
"	Sabine	737 .96	.96998				
"	Henry	593 .81	.97018				
New Haven,	Hansteen	884 .27	.92497	.92364	73 26 .7	.99533	1.7800
"	Sabine	756 .40	.92326				
"	Henry	608 .90	.92269				
Dorchester,	Hansteen	904 .35	.88435	.88182	74 16 .0	.99854	1.7858
"	Sabine	773 .45	.88301				
"	Henry	624 .17	.87810				
Providence,	Hansteen	897 .46	.89798	.89830	73 59 .6	1.00027	1.7889
"	Sabine	766 .70	.89862				
Princeton,	Hansteen	862 .29	.97273	.97414	72 47 .1	1.01066	1.8075
"	Sabine	734 .22	.97989				
"	Henry	593 .93	.96979				
Philadelphia,	Hansteen	850 .45	1.00000	1.00000	72 7 .1	1.00000	1.7884
"	Sabine	726 .80	1.00000				
"	Henry	584 .89	1.00000				
Hudson,	Hansteen	860 .74	.97623	.97344	72 47 .6	1.01040	1.8070
"	Sabine	737 .11	.97222				
"	Henry	593 .29	.97188				

From the preceding observations it may be inferred that New York and Hudson have sensibly the same magnetic intensity, as well as dip.

The only published observations, so far as I am aware, with which the preceding can be compared, are those made by President Bache and Professor Courtenay, and published in the Society's Transactions, Vol. VI., pp. 427—457. The horizontal intensity at New York, (that at Philadelphia being considered unity,) was found, by observations in common air, .97202; by observations in rarefied air, .94702. Mean of the two determinations, allowing each its proper weight, .94705. My own result is .96707. The horizontal intensity at Providence, by President Bache's observations, is .89869; by my own, .89830.

Magnetic Dip.

The following observations of the dip in different azimuths were made with the same instrument formerly described, for the purpose of testing the axles of the needles. They were made at Hudson, from August 27 to September 4, 1840, on the same spot formerly employed. The same mode of observing was adhered to, and each number in the two columns headed "Poles direct," "Poles reversed," is the mean of twenty readings, five being made of each pole in one position of the needle, and the same number after the needle was reversed upon its supports. Thus, 1360 readings were made with each needle. The dip is deduced from the formula $cot.^2\ \delta = cot.^2\ i + cot.^2\ i'$.

Needle No. 1.

Azimuth.	Poles direct.	Poles reversed.	Mean.	Dip deduced.
0	72°26′.4	72°37′.8	72°45′.6	72°45′.6
180	72 51 .9	73 6 .3		
10	72 40 .2	72 54 .9	73 2 .7	72 46 .1
190	73 11 .6	73 24 .0		
100	86 9 .5	87 18 .9	86 44 .2	
280	86 52 .4	86 35 .8		
20	73 24 .6	73 30 .0	73 42 .7	72 46 .1
200	73 52 .3	74 3 .7		
110	84 13 .6	84 32 .8	84 3 .8	
290	83 49 .8	83 38 .8		
30	74 36 .1	74 44 .6	74 56 .2	72 47 .7
210	75 4 .4	75 19 .7		
120	81 20 .1	81 35 .1	81 17 .6	
300	81 1 .8	81 13 .1		
40	76 18 .8	76 31 .1	76 40 .3	72 49 .8
220	76 47 .1	77 4 .3		
130	78 57 .8	79 12 .4	78 46 .8	
310	78 31 .1	78 25 .8		

Azimuth.	Poles direct.	Poles reversed.	Mean.	Dip deduced.
50	78°23′.5	78°30′.8	78°45′.8	72°48′.4
230	78 49 .0	79 19 .7		
140	76 47 .0	77 3 .6	76 39 .2	
320	76 23 .5	76 22 .8		
60	81 9 .7	80 57 .2	81 16 .9	72 49 .5
240	81 18 .5	81 42 .1		
150	75 3 .5	75 24 .0	74 58 .7	
330	74 40 .8	74 46 .6		
70	83 42 .7	83 34 .3	83 56 .2	72 47 .8
250	84 5 .7	84 21 .9		
160	73 58 .0	74 7 .1	73 47 .1	
340	73 29 .0	73 34 .2		
80	86 45 .7	86 31 .1	86 54 .2	72 45 .8
260	87 2 .6	87 17 .4		
170	73 9 .2	73 21 .7	73 0 .8	
350	72 42 .3	72 49 .8		
General mean, 72° 47′.4				

Needle No. 2.

Azimuth.	Poles direct.	Poles reversed.	Mean.	Dip deduced.
0	72° 57′.8	72° 32′.7	72° 53′.5	72° 53′.5
180	72 56 .4	73 7 .0		
10	73 14 .5	72 45 .8	73 9 .7	72 55 .0
190	73 17 .9	73 20 .3		
100	87 8 .6	87 18 .3	86 56 .9	
280	86 39 .4	86 41 .3		
20	73 54 .4	73 29 .3	73 50 .9	72 54 .8
200	74 4 .2	73 55 .8		
110	84 10 .5	84 28 .8	84 7 .1	
290	83 58 .5	83 50 .6		
30	74 55 .2	74 31 .4	74 59 .0	72 46 .6
210	75 20 .9	75 8 .2		
120	81 19 .2	81 28 .2	81 9 .1	
300	80 56 .4	80 52 .4		
40	76 51 .2	76 6 .4	76 43 .4	72 55 .1
220	76 57 .9	76 56 .1		
130	79 11 .7	79 8 .6	78 51 .9	
310	78 40 .9	78 26 .3		

Azimuth.	Poles direct.	Poles reversed.	Mean.	Dip deduced.
50	78° 45′.2	78° 24′.2	78° 52′.9	72° 59′.3
230	79 14 .0	79 8 .0		
140	77 0 .0	76 57 .0	76 48 .2	
320	76 58 .8	76 16 .8		
60	80 54 .2	80 51 .3	81 6 .2	72 47 .2
240	81 13 .8	81 25 .4		
150	75 21 .6	75 10 .4	75 1 .8	
330	74 59 .7	74 35 .2		
70	83 56 .7	83 43 .4	84 0 .1	72 52 .6
250	83 57 .1	84 23 .1		
160	74 3 .7	74 1 .7	73 50 .8	
340	73 47 .9	73 29 .9		
80	86 37 .5	86 41 .5	86 53 .2	72 51 .9
260	87 1 .4	87 12 .3		
170	73 14 .5	73 16 .7	73 7 .2	
350	73 13 .3	72 44 .1		
General mean, 72° 52′.9				

The results with needle No. 1 are quite satisfactory, the extreme range of the values of the dip from observations in different azimuths being 4′.2. With needle No. 2 the extreme range is 12′.7. This discordance is ascribed to slight rust which has formed upon one of the axles, but which is barely discernible to the naked eye. The mean of the preceding 2720 readings with both needles is 72° 50′.2; the mean of the observations in the meridian is 72° 49′.6. Difference 0′.6. In these observations 0 of azimuth is intended to indicate the magnetic meridian. The dip may then be deduced by the formula $cot.\ \delta = cot.\ i.\ sec.\ \theta$. The following table gives the result of this comparison:

	Needle No. 1.		Needle No. 2.	
Azimuth.	Inclination.	Dip.	Inclination.	Dip.
0	72° 45′.6	72° 45′.6	72° 53′.5	72° 53′.5
10	73 1 .7	" 46 .9	73 8 .4	" 53 .7
20	73 44 .9	" 45 .9	73 50 .9	" 52 .2
30	74 57 .5	" 45 .6	75 0 .4	" 48 .9
40	76 39 .8	" 48 .2	76 45 .8	" 55 .8
50	78 46 .3	" 50 .2	78 52 .4	" 59 .2
60	81 17 .2	" 57 .6	81 7 .6	" 39 .7
70	84 0 .0	" 55 .0	84 3 .6	" 64 .8
80	86 49 .2	" 15 .4	86 55 .1	" 46 .3
	Mean Dip,	72° 45′.6	Mean Dip,	72° 52′.7

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*That the dips obtained by this method should not perfectly accord with each other will not appear strange when it is considered that an error of one minute in the observed azimuth at eighty degrees causes an error of nearly two minutes in the computed dip; and an error of one minute in the observed inclination causes an error of more than five minutes in the computed dip. The mean result with the two needles by the last method is 72° 49′.1; by the former method of combination, 72° 50′.2; mean of the two methods, 72° 49′.6, which accords perfectly with the result of observations in the meridian.

* The part of this paper which follows, was read November 20, 1840.

The preceding trial appears to me to justify confidence in the needles employed, and to give additional value to my former observations.

The following observations were made in the usual manner:

Magnetic Dip at Hudson, Ohio. Latitude 41° 15′ *N.; Longitude* 81° 26′ *W.*

Date.	Hour.	Needle.	No. Readings.	Dip.
1840, April 15th,	$8\frac{1}{2}$—11, A. M.	No. 1,	40	72° 50′.3
" " "	" "	No. 1, poles reversed,	40	44 .1
" " "	" "	Mean of No. 1,	80	47 .2
" " "	" "	No. 2,	40	69 .5
" " "	" "	No. 2, poles reversed,	40	49 .0
" " "	" "	Mean of No. 2,	80	59 .2
" " "	" "	Mean of both needles,	160	72 53 .2

Magnetic Dip at Aurora, Ohio. Latitude 41° 20′ *N.; Longitude* 81° 20′ *W.*

Place of observation thirty rods north-west of the Presbyterian church.

Date.	Hour.	Needle.	No. Readings.	Dip.
1840, Sept. 8th,	9—11, A. M.	No. 1,	40	72° 51′.0
" " "	" "	No. 1, poles reversed,	40	48 .4
" " "	" "	Mean of No. 1,	80	49 .7
" " "	" "	No. 2,	40	57 .3
" " "	" "	No. 2, poles reversed,	40	65 .1
" " "	" "	Mean of No. 2,	80	61 .2
" " "	" "	Mean of both needles,	160	72 55 .5

Magnetic Dip at Windham, Ohio. Latitude 41° 15′ *N.; Longitude* 81° 3′ *W.*

Place of observation fifty rods north of the Presbyterian church.

Date.	Hour.	Needle.	No. Readings.	Dip.
1840, Sept. 8th,	3—5, P. M.	No. 1,	40	72° 57′.2
" " "	" "	No. 1, poles reversed,	40	59 .7
" " "	" "	Mean of No. 1,	80	58 .5
" " "	" "	No. 2,	40	73 14 .9
" " "	" "	No. 2, poles reversed,	40	1 .7
" " "	" "	Mean of No. 2,	80	8 .3
" " "	" "	Mean of both needles,	160	73 3 .4

Magnetic Dip at Bazetta, Ohio. Latitude 41° 20′ *N.; Longitude* 80° 45′ *W.*

Place of observation near the centre of the township.

Date.	Hour.	Needle.	No. Readings.	Dip.
1840, Sept. 9th,	11½—1, P. M.	No. 1,	40	72° 58′.4
" " "	" "	No. 1, poles reversed,	40	57 .3
" " "	" "	Mean of No. 1,	80	57 .9
" " "	" "	No. 2,	40	61 .1
" " "	" "	No. 2, poles reversed,	40	61 .8
" " "	" "	Mean of No. 2,	80	61 .5
" " "	" "	Mean of both needles,	160	72 59 .7

Magnetic Dip at Kinsman, Ohio. Latitude 41° 30′ *N.; Longitude* 80° 34′ *W.*

Place of observation half a mile south-west of the centre of the township.

Date.	Hour.	Needle.	No. Readings.	Dip.
1840, Sept. 10th,	9—11, A. M.	No. 1,	40	73° 2′.0
" " "	" "	No. 1, poles reversed,	40	8 .9
" " "	" "	Mean of No. 1,	80	5 .5
" " "	" "	No. 2,	40	10 .5
" " "	" "	No. 2, poles reversed,	40	11 .1
" " "	" "	Mean of No. 2,	80	10 .8
" " "	" "	Mean of both needles,	160	73 8 .1

Magnetic Dip at Hartford, Ohio. Latitude 41° 19′ *N.; Longitude* 80° 34′ *W.*

Place of observation one mile south of the centre of the township.

Date.	Hour.	Needle.	No. Readings.	Dip.
1840, Sept. 10th,	4—5½, P. M.	No. 1,	40	72° 55′.9
" " "	" "	No. 1, poles reversed,	40	51 .4
" " "	" "	Mean of No. 1,	80	53 .7
" " "	" "	No. 2,	40	64 .0
" " "	" "	No. 2, poles reversed,	40	68 .0
" " "	" "	Mean of No. 2,	80	66 .0
" " "	" "	Mean of both needles,	160	72 59 .8

Magnetic Dip at Warren, Ohio. Latitude 41° 16′ *N.; Longitude* 80° 49′ *W.*

Place of observation a few rods east of the village.

Date.	Hour.	Needle.	No. Readings.	Dip.
1840, Sept. 11th,	12—1½, P. M.	No. 1,	40	72° 55′.2
" " "	" "	No. 1, poles reversed,	40	59 .9
" " "	" "	Mean of No. 1,	80	57 .6
" " "	" "	No. 2,	40	73 4 .2
" " "	" "	No. 2, poles reversed,	40	3 .4
" " "	" "	Mean of No. 2,	80	3 .8
" " "	" "	Mean of both needles,	160	73 0 .7

Magnetic Dip at Cleveland, Ohio. Latitude 41° 30′ *N.; Longitude* 81° 42′ *W.*

Place of observation half a mile south of the American House.

Date.	Hour.	Needle.	No. Readings.	Dip.
1840, Sept. 22d,	2—4, P. M.	No. 1,	40	73° 17′.4
" " "	" "	No. 1, poles reversed,	40	16 .0
" " "	" "	Mean of No. 1,	80	16 .7
" " "	" "	No. 2,	40	7 .0
" " "	" "	No. 2, poles reversed,	40	7 .6
" " "	" "	Mean of No. 2,	80	7 .3
" " "	" "	Mean of both needles,	160	73 12 .0

This result accords better with other observations than my former observation at this place, and is believed to represent more accurately the true dip.

Magnetic Dip at Bedford, Ohio. Latitude 41° 24′ *N.; Longitude* 81° 32′ *W.*

Place of observation a quarter of a mile south of the village.

Date.	Hour.	Needle.	No. Readings.	Dip.
1840, Sept. 23d,	1—3, P. M.	No. 1,	40	72° 50′.6
" " "	" "	No. 1, poles reversed,	40	58 .3
" " "	" "	Mean of No. 1,	80	54 .5
" " "	" "	No. 2,	40	64 .8
" " "	" "	No. 2, poles reversed,	40	58 .5
" " "	" "	Mean of No. 2,	80	61 .6
" " "	" "	Mean of both needles,	160	72 58 .1

Magnetic Dip at Twinsburgh, Ohio. Latitude 41° 20′ *N.*; *Longitude* 81° 26′ *W.*

Place of observation a quarter of a mile north of the village.

Date.	Hour.	Needle.	No. Readings.	Dip.
1840, Sept. 23d,	4—5, P. M.	No. 1,	40	72° 54′.8
" " "	" "	No. 1, poles reversed,	40	48 .7
" " "	" "	Mean of No. 1,	80	51 .8
" " "	" "	No. 2,	40	48 .2
" " "	" "	No. 2, poles reversed,	40	53 .3
" " "	" "	Mean of No. 2,	80	50 .8
" " "	" "	Mean of both needles,	160	72 51 .3

Magnetic Dip at Tallmadge, Ohio. Latitude 41° 6′ *N.; Longitude* 81° 26′ *W.*

Place of observation half a mile south-west of the village.

Date.	Hour.	Needle.	No. Readings.	Dip.
1840, Sept. 28th,	8—9½, A. M.	No. 1,	40	72° 43′.6
" " "	" "	No. 1, poles reversed,	40	54 .1
" " "	" "	Mean of No. 1,	80	48 .9
" " "	" "	No. 2,	40	53 .8
" " "	" "	No. 2, poles reversed,	40	49 .0
" " "	" "	Mean of No. 2,	80	51 .4
" " "	" "	Mean of both needles,	160	72 50 .1

I have always aimed to remove all iron from my person before commencing a series of observations; but after concluding the preceding, I found, to my surprise, an iron key in my coat pocket. The observations were, therefore, subsequently repeated in the same place.

Magnetic Dip at Shalersville, Ohio. Latitude 41° 15′ *N.; Longitude* 81° 13′ *W.*

Place of observation forty rods west of the Presbyterian church.

Date.	Hour.	Needle.	No. Readings.	Dip.
1840, Oct. 15th,	2½—4, P. M.	No. 1,	40	72° 59′.1
" " "	" "	No. 1, poles reversed,	40	51 .9
" " "	" "	Mean of No. 1,	80	55 .5
" " "	" "	No. 2,	40	54 .3
" " "	" "	No. 2, poles reversed,	40	61 .0
" " "	" "	Mean of No. 2,	80	57 .6
" " "	" "	Mean of both needles,	160	72 56 .6

Magnetic Dip at Streetsboro, Ohio. Latitude 41° 15′ *N.; Longitude* 81° 20′ *W.*

Place of observation a quarter of a mile west of the village.

Date.			Hour.		Needle.	No. Readings.	Dip.
1840,	Oct.	16th,	9—11, A. M.		No. 1,	40	72° 46′.2
"	"	"	"	"	No. 1, poles reversed,	40	55 .8
"	"	"	"	"	Mean of No. 1,	80	51 .0
"	"	"	"	"	No. 2,	40	52 .6
"	"	"	"	"	No. 2, poles reversed,	40	57 .4
"	"	"	"	"	Mean of No. 2,	80	55 .0
"	"	"	"	"	Mean of both needles,	160	72 53 .0

Magnetic Dip at Tallmadge, Ohio. Latitude 41° 6′ *N.; Longitude* 81° 26′ *W.*

Place of observation the same as formerly.

Date.			Hour.		Needle.	No. Readings.	Dip.
1840,	Oct.	31st,	2—3½, P. M.		No. 1,	40	72° 53′.5
"	"	"	"	"	No. 1, poles reversed,	40	44 .1
"	"	"	"	"	Mean of No. 1,	80	48 .8
"	"	"	"	"	No. 2,	40	47 .6
"	"	"	"	"	No. 2, poles reversed,	40	47 .5
"	"	"	"	"	Mean of No. 2,	80	47 .5
"	"	"	"	"	Mean of both needles,	160	72 48 .2

This result is almost identical with the former observation, indicating that the effect of the iron key was scarcely appreciable.

The preceding observations, as well as those which I have formerly made in Ohio and Michigan, are tolerably well represented by parallel, straight, and equidistant isoclinal lines, running from N. 80° W. to S. 80° E.; and the line of 73° passes five or six miles south of Cleveland.